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ASP Report on the 1030/1090 MHz RF Development

(Presented by Roland Mallwitz)

Summary

1030/1090 MHz is the link ensuring global interoperability for aeronautical surveillance. ASP acknowledges the need to carefully establish current use of this link and to predict its future use and the development of the RF environment.

ASP accepted the tasks given by the ANC. This Working Paper contains the conclusions and recommendations of the report.

1030/1090 MHz is the link ensuring global interoperability for aeronautical surveillance. ASP acknowledges the need to carefully establish current use of this link and to predict its future use and the development of the RF environment.

1090 MHz is currently the worldwide interoperable ADS-B link. The ASP is following studies performed at different places in the world showing suitability of the 1090 link to support ADS-B applications over a longer period than initially anticipated (until 2015) to save investments by airlines and service providers. ASP is also following studies performed within several states discussing possibilities and options and their effect on the RF environment.

Requiring ACAS equipage and implementing Mode S or ADS-B at the same time, several member states have started activities to investigate and forecast the development of channel occupancy on 1030/1090 MHz frequencies, which are shared by civil and military systems. These systems include ACAS, ADS-B (extended Squitter), secondary surveillance radar, SSR Mode S and military (stationary and mobile) systems to support applications for identification or formation flight. All these systems contribute to the RF interference on 1030 and 1090 MHz.

Following deployment of new systems RF measurement campaigns and simulation activities have been performed. ASP is also investigating possible impact on 1030/1090 of active WAM deployment and new Air-Air systems being developed as Mil-ACAS."

A report presenting a summary of the expected development of the RF environment following Mode S deployment, on the impact from new systems deployment (e.g. active WAM, Mil-ACAS) and the potential of improving ADS-B to support future applications is being prepared.

4. Conclusions and Recommendations

*(recommendations in **bold**)*

In general, the

- **efficient use of the 1030/1090 MHz environment through transmission management, interrogation rate management and the appropriate antenna design**

for each system is a prerequisite to ensure proper operation of all surveillance systems.

The dominant form of FRUIT by 2015 is likely to be Mode S rather than Mode A/C (which is a different conclusion from previous studies) and independent of the ground environment. It also shows that radar infrastructure rationalisations, interrogator power and interrogation rate management and antenna design, could lead to significant FRUIT level reductions. FRUIT levels have been investigated as expected in 2015 given implementation of civil Mode S radars and conventional SSR. As such, FRUIT can be significantly reduced by

- **clustering of Mode S radar;**
- **regional ground system coordination;**
- **Improved cooperation between civil and military authorities;**
- **Use of correct and correctly tested and maintained equipment.**

The modes of operation of civil and military radars have a large effect on the amount of interference produced by them. Decoding 1090 ES messages in the presence of Mode S FRUIT (either from other 1090 ES messages, short squitters, ACAS or replies to Mode S radars) is significantly more challenging than in the presence of Mode A/C FRUIT. Therefore,

- a coordinated and between all parties agreed **transition to Mode S** from all parties is beneficial.

Even airborne Mode S equipage only will reduce the 1090 MHz channel load. ACAS air-air performance will be improved with hybrid surveillance, but no significant change is expected for ground system performance. New ACAS equipment should be able to acquire other aircraft also on the basis of extended squitter.

- **The use of hybrid surveillance for ACAS is recommended.**

With the increasing carriage of ACAS by aircraft and the increasing traffic densities.

- **Investigations are necessary to improve ACAS interference limiting for future aircraft densities, while ensuring sufficient surveillance performance for all surveillance systems.**

The FRUIT generated through the transmission of Extended Squitter is higher than the reduction through other effects like hybrid surveillance implementation. The specified maximum rate of 6.2 extended squitters per second is at the edges in high traffic density area. Some compensation can be achieved by disabling the transmission of acquisition squitters.

- **Disabling Acquisition squitters** in extended squitter capable installations will reduce the overall fruit load and increase ACAS surveillance performance. This requires new ACAS equipment (from 2009 and onwards).

There are ICAO provisions to suppress the acquisition squitter in the future. With the rapid implementation of ADS-B out this option can help to overcome detrimental FRUIT effects.

Due to the expected effect of the use of Squitter transmission in high density areas above the 6.2 squitter per second rate, it is recommended to.

- **Investigate the possibilities of adapting squitter rates and transmission power to the actual environment and application needs.**

This will ensure the usage of extended squitter as a long term ADS-B medium for global interoperability.

1090 MHz FRUIT rates are likely to decrease after a transition period beyond ~2015. Some radar infrastructure is likely to be decommissioned and replaced by ADS-B stations leading to a reduction in interrogations and hence in FRUIT. In following years, the air traffic growth will eventually compensate for the reduction in interrogations and furthermore the level of 1090ES FRUIT will become more and more critical. Consequently 1090ES system performance can be expected to improve for some period beyond 2015 and then gradually degrade again.

It will be important however to keep monitoring FRUIT levels and perform follow-on studies following any changes in predictions for air traffic growth and the evolution of national plans for surveillance infrastructure.

If TIS-B should be implemented, this has to be carried out very carefully. The transmission rates should be as low as possible. Filling surveillance gaps could result in a safety benefit which justifies the additional channel load. Adjacent or overlapping coverage will only be possible in areas with low traffic density.

In general, for ground systems: .

- **The move towards passive acquisition (ADS-B, Multilateration) should be encouraged**
- To ensure compatibility and the use in the future, **active Multilateration systems should have minimal impact on the surveillance environment**.

Equipage of new user groups with Mode S transponders (light aviation) or ACAS (Very Light Jets) needs careful investigation and analysis and may influence existing equipment on the ground and in the air.

- **New equipage should not only be considered in regard to its own operation but also how it influences existing equipment**
- **New equipment has to be introduced in a manner that will allow existing equipment not to be unduly degraded in its performance,**

A lot of negative effects could be avoided, if malfunctioning or non-interoperable equipment is detected early.

- **Monitoring of the RF environment and periodic testing of equipment should be encouraged.**